MICROBIAL ECOLOGY OF HIGH TEMPERATURE BIOTOPES

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On Earth, geothermal environments support vibrant communities of hyperthermophilic microorganisms capable of growing at temperatures of 80∞C and higher. These microorganisms, thought to represent the earliest life forms on Earth, have metabolic features consistent with their possible colonization of extraterrestrial niches where liquid water and thermal energy are available. Thus, insights into how hyperthermophiles interact with and within their environment will offer clues to the evolution of primitive life on Earth and provide a basis for searching for life in other parts of the universe. A functional genomics approach is being used to study three model hyperthermophilic microorganisms: Pyrococcus furiosus, Thermotoga maritima and Methanococcus jannaschii, that have complementary physiological characteristics and for which complete genome sequence data are available. These hyperthermophiles are being examined individually and in mixed cultures for physiological characteristics that relate to physical, chemical and biological aspects of their growth environment, inter- and intra-species interactions, and propensity for forming biofilms. These issues are central to understanding the evolution of life on this planet and to the exploration of extraterrestrial worlds for microbiological phenomena. Biofilm formation has been noted in cultures of both P. furiosus and T. maritima (1), and transcriptional response analysis was used to compare phenotypic differences between planktonic and sessile cells (2). Results to date have shown that quorum sensing, a microbial signaling process thus far described only for mesophilic bacteria, occurs in hyperthermophilic cultures. T. maritima produces a signaling peptide (TM0504), the putative mature form of which induced exopolysaccharide formation in pure cultures (3). Co-cultivation of T. maritima with M. jannaschii influenced cell densities of the heterotroph as well as its gene expression during the transition from exponential to stationary phase (4). Initial results indicate that P. furiosus also utilizes a form of quorum sensing. To investigate the role of biologically-active small molecules in high temperature biotopes, a chloramphenicol-resistant mutant of T. maritima was isolated and differential gene expression experiments were used to examine mechanisms of antibiotic resistance (5). Among other findings was that a trans-translation ribosome rescue process (tmRNA) was operable in T. maritima and induced upon exposure to chloramphenicol.

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3. Johnson, MR, et al. 2005, Mol Microbiol 55, 664
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